Responses of temperate mobile macroinvertebrates to reef habitat structure and protection from fishing

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Frontispiece: *Heliocidaris erythrogramma* in reef refuge

Declaration of originality

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Statement of co-authorship

As primary supervisor, Dr. Graham J. Edgar contributed general advice and editing to all chapters.

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Chapter 4: N.S. Barrett and G.J. Edgar provided invertebrate, fish and macroalgae data.

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Abstract

This study assesses the importance of crevices and other physical aspects of reef structure to macroinvertebrates associated with rocky reefs. No-take marine reserves have the potential to interact with reef structure to influence the organisation of the benthic community. Despite wide recognition that such relationships influence ecosystem structure, very few quantitative field studies have reported previously on relationships between reef structure and macroinvertebrates at the assemblage level, and none on interactions additionally involving protection from fishing.

The relative importance of protection from fishing and reef habitat structure were determined by surveying reef structure and invertebrates at three spatial scales at protected and fished sites around the 'no-take' Maria Island marine reserve. Small reef features and protection from fishing both affected abundances of the majority of taxa, while rugosity – the most commonly employed metric of reef structure – proved to be a poor predictor of invertebrate abundance and richness. Models developed on the basis of Tasmanian data that use habitat surrogates to describe the spatial distribution of invertebrate assemblages and populations were found to have limited predictive ability when applied in New South Wales and Western Australian bioregions. Single habitat predictors tended to dominate species models for each bioregion suggesting that surrogates identified in one region should not be extrapolated outside that region without local validation. Analysis of a long-term (16 years) ecological dataset from eastern Tasmania indicated that the strength of relationships between reef structure and exploited rock lobsters (*Jasus edwardsii*) decreased within newly-declared MPAs. Cascading trophic effects also apparently affected habitat links for prey sea urchins (*Heliocidaris erythrogramma*) and abalone

(*Haliotis rubra*). Given the changing nature of relationships through time and space, caution is clearly required when generalising from results of studies undertaken in a single time period or single region.

Cryptic invertebrates sampled below flat sandstone blocks were significantly influenced by the surface structure of the underlying reef. These cryptofaunal assemblages were similar between sites inside and outside the Maria Island marine reserve; however juvenile abalone, one of the most abundant species in this habitat, were recorded in much lower numbers at protected sites. Combined with evidence of declining adult populations, this finding suggests the possibility that recruitment failure may occur for abalone populations in Tasmanian marine reserves with abundant rock lobsters.

Through analysis of relationships between mobile invertebrates and reef structure at protected and fished sites, and at multiple spatial- and temporal-scales, this project has provided valuable insight into temporal stability and instability, and spatial specificity of linkages between temperate reef-associated invertebrates and their environment.

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